PLAUSIBLE COMPLIANCE SCENARIOS FOR THE 33% RENEWABLE ELECTRICITY STANDARD

Plausible Scenario Background

The plausible compliance scenarios for the 33% renewable electricity standard (RES) are a fundamental element of a proposed RES in California. In order to conduct a thorough analysis, a set of theoretical possibilities, or "plausible compliance scenarios," will be used to evaluate a range of potential renewable energy outcomes. These scenarios are for analytical purposes only to proceed with technical, environmental, and economic analyses for the proposed RES regulation. The scenarios reflect possible approaches, not required approaches to comply.

Each of the scenarios presented account for varying degrees of energy efficiency, combined heat and power (CHP), and distributed solar generation (Solar DG). Although the scenarios may not fully incorporate parameters related to permitting, construction, and ideal load balancing situations, these aspects are under evaluation and will be used to facilitate implementation of the 33% RES regulation.

The resulting three scenarios are based on output data obtained from the Renewable Portfolio Standard (RPS) Calculator developed by Energy and Environmental Economics, Inc. (E3). The scenarios were developed with information obtained from the California energy agencies, private consultants, and stakeholder input.

High Net Short	This scenario, also considered the baseline or "worst case" scenario, uses the 2009 Integrated Energy Policy Report (IEPR) load forecast to evaluate the additional renewable energy needed to meet the 33% target. The forecast uses historical data to draw assumptions and includes embedded values for CHP and Solar DG, including rooftop and wholesale sources, but does not include reductions from the ARB's Scoping Plan measures.
Medium Net Short	This scenario reflects a middle ground between the High and Low Net Short scenarios. This scenario incorporates approximately half of the load reduction strategies found in the Low Net Short Scenario.
Low Net Short	This scenario reflects changes to the High Net Short Scenario by including modifications to incorporate ARB Scoping Plan measures for items including Energy Efficiency, CHP, and Solar DG energy. The result is a lower

need for renewable energy as compared to the 2020 High Net Short Scenario.

See Attachment 1 for details.

Inputs and Assumptions

Each scenario includes a complex set of inputs and parameters that are based on best available assumptions. The method of transforming these parameters into plausible scenarios is an iterative process that uses the E3 RPS Calculator. The calculator processes multiple parameters such as the load forecast, environmental concerns and cost impacts to develop a resulting plausible scenario. A more detailed explanation of the specific inputs is described in the sections that follow.

Renewable Zones and Transmission Corridors

The E3 RPS Calculator relies on estimates of renewable resource availability and performance from four sources:

1. The CPUC Energy Division maintains a database of projects resulting from IOU renewable energy solicitations located in California and within the Western Electricity Coordinating Council (WECC) region.

2. For resources located in Competitive Renewable Energy Zones (CREZs) in California, the model uses data produced by the Renewable Energy Transmission Initiative (RETI) process sponsored by the CPUC, CEC, and California utilities.

3. For resources located outside of California, the model relies on a dataset developed by E3 in 2007 for the CPUC and Western Electric Industry Leaders (WEIL) Group.

4. For distributed renewable resources, E3 worked with Black & Veatch to develop estimates of Solar PV potential on large rooftops in urban areas and near remote, rural substations.

The E3 RPS Calculator assumes that new high-voltage transmission lines must be constructed in order to deliver renewable energy resources located in CREZs or from out of state regions. The calculator is updated frequently to ensure that specific facilities and related cost impacts are as up to date as possible.

Cost and Performance Related to Supply

The installed costs of facilities, capacity factors, and on-peak availability of each resource were derived principally from the RETI analysis. In the case of wind,

the on-peak availability is based on the 2009 Net Qualifying Capacity used by CAISO. These assumptions use the most current information available.

Natural Gas and CO2 Price Forecasting

The natural gas fuel price forecast is based on the 2020 Henry Hub Natural Gas Price as traded on NYMEX, and the basis spread for delivery to California comes from the 2009 Market Price Referent. The E3 RPS Calculator currently contains Henry Hub prices from late 2008; however, the natural gas price forecast will be updated using the most current publicly available information. The CO2 price forecast is based on a 2008 report prepared by Synapse Energy Economics, Inc. and adopted by the CPUC in the market price reference proceeding.

Financing Assumptions

The E3 RPS Calculator assumes that all projects will be developed by independent power producers using a 20-year financing life. Biomass, geothermal, and small hydro receive a production tax credit (PTC) of $0.01/kWh (in 2008 dollars), while biogas and wind receive a PTC of $0.02/kWh. Solar PV and solar thermal projects receive an investment tax credit of 30%, which is available to cover 95% of the total capital investment. All renewable projects also benefit from accelerated depreciation according to a 5-year Modified Accelerated Cost Recovery System (MACRS). All current federal tax incentives are assumed to remain in place through 2020.

Calculation of Renewable Resources for Meeting the 33% RES

The 33% RES requirement used for the plausible scenarios is based on the 2009 IEPR forecast, with adjustments in the Low Net Short and Medium Net Short scenarios to reflect CHP, Energy Efficiency, and Solar DG. The latest forecast estimates total 2020 retail electricity sales to be 290 TWh. The total quantity of renewable energy required to meet a 33% RES under the High Net Short scenario is therefore 33% of 290 TWh, or 96 TWh. California utility renewable energy claims amount to approximately 32 TWh in 2009; hence, the Renewable Net Short is 96 – 32 = 64 TWh. The values for the Low Net Short and Medium Net Short scenarios are 52 TWh and 58 TWh, respectively, reflecting the assumption of policy-driven reductions in 2020 retail electricity sales.

Once-Through-Cooling and Coal Plant Retirement

Once-Through Cooling

Assumptions regarding Once-Through-Cooling (OTC) from power plants located along coastal waters were derived by using a draft State Water Board Ruling combined with assumptions derived by the California energy agencies. The scenario assumes the retirement of all units scheduled to be retired (or otherwise brought into compliance with the Water Board's OTC policy) by

2020. This includes 16,178 MW of fossil fuel-burning facilities but does not include the Diablo Canyon or San Onofre nuclear facilities.

Coal Plant Retirement

The E3 RPS Calculator does not assume retirement of any coal-fired resources serving California loads by 2020. The model focuses solely on the cost and GHG impacts of meeting 33% of retail sales with renewables and does not model the impacts of other potential GHG-reducing measures in the energy sector.

Energy Balancing

The E3 RPS Calculator balances the plausible scenarios by adding a combination of Combined Cycle Gas Turbines (CCGTs) and Simple Cycle Gas Turbines (SCGTs) to meet any residual energy and/or capacity needs after the renewable resources have been added. This particular method of load balancing was developed by simulating a 8760-hour energy dispatch of the 33% Reference Case Scenario using a simplified, four-period analysis (summer heavy-load hour, summer light-load hour, winter heavy-load hour, winter light-load hour). A related effort to determine energy balancing needs and capabilities will be conducted by the CAISO in an operational study described below.

Renewable Energy Credits and New Plausible Scenarios

The ARB is evaluating the roles and impacts that renewable energy credits (RECs) may have on each of the plausible scenarios. RECs could allow renewable energy to be generated and consumed in other jurisdictions within the WECC framework and allow the REC to be traded in California where California utilities purchase the renewable energy "attribute" only. Such a system could significantly affect the existing scenarios by increasing the amount of energy procured from out-of-state jurisdictions and lessen the overall transmission line requirements and associated cost impacts. The ARB is developing an expanded scope of work to request E3 to analyze the impacts of allowing Tradable RECs on the 33% plausible scenarios. The proposed expanded scope of work related to new REC scenarios includes:

1. *Establishing REC generating criteria for out-of-state regions.*

   This task establishes criteria used to estimate potential Tradable REC energy generated outside of California, but within the WECC framework, and analyzes the likelihood that such sources may become operational within the 2010-20 timeframe. The criteria will include an analysis of the supply and demand for renewable energy resources in each WECC jurisdiction, as well as set limits on the amount of renewable energy that can be developed for the purpose of generating Tradable RECs for sale in California. These limits will prevent excess energy from being

incorporated into the model by constraining the amount of energy that individual WECC jurisdictions can feasibly consume.

2. *Computing cost and market impacts.*

   This task evaluates the cost and economic impact of undelivered RECs using criteria specified in Task 1 for new plausible scenarios that reflect REC impacts. The scenarios will be analyzed using an extension to the E3 RPS Calculator. New versions of the Calculator will be available to the ARB, California energy agencies, and stakeholders for review.

Pending Analyses

The CAISO, while working jointly with the CPUC, CEC and market stakeholders, is currently undertaking a 33% renewables operational study with initial results due in the first quarter of 2010. In addition to the plausible scenarios, that study will conduct an analysis of operational impacts, variable integration costs, and fixed capacity costs for additional renewable supply cases, including high distributed generation and high out-of-state resource cases. This will provide a preliminary estimate of additional generation resources needed for renewable integration. Later phases of the study will examine the impact of additional control over renewable output and the introduction of storage and demand response as integration resources.

In the first quarter of 2010, the CPUC anticipates releasing a new analysis that includes a range of plausible alternative procurement strategies, based on a more realistic implementation assessment of the original alternative cases. These updates are anticipated to provide the full range of outputs identified in the Proposed Technical Feasibility Analysis for a broader range of plausible alternative cases.

In a related effort, the California Transmission Planning Group (CTPG), which includes municipal utilities, investor-owned utilities and the CAISO, is working with the RETI and CPUC to define renewable portfolios for use in state-wide transmission planning studies. This group, followed by CAISO, is intended to develop a transmission master plan for California to support 33% renewables by the end of 2010.

Attachment 1
Plausible Compliance Scenarios for the 33% RES
(excludes existing renewable resources)

2020 HIGH Net Short				Load Adjustments:
Type	**%**	**MW**	**GWh**	Energy Efficiency: 0 CHP: 0 Solar DG: 0 Total Load 290,000 GWh 20% RPS Energy Req'd 27,000 GWh
Small Hydro	0.2%	40	177	
Biogas	1.4%	279	2,077	
Biomass	2.0%	429	3,003	
Geothermal	7.4%	1,497	11,472	
Solar PV	16%	3,165	6,764	
Solar Thermal	32%	6,513	16,087	
Wind	41%	8,338	24,547	
33% RES Energy Req'd	100%	*20,261*	*64,127*	

2020 MEDIUM Net Short				Load Adjustments:
Type	**%**	**MW**	**GWh**	Energy Efficiency: 12,100 GWh CHP: 15,185 GWh Solar DG: 0 Total Load 270,000 GWh 20% RPS Energy Req'd 23,000 GWh
Small Hydro	0.2%	40	177	
Biogas	1.5%	279	2,077	
Biomass	1.7%	328	2,297	
Geothermal	7.5%	1,395	10,689	
Solar PV	16%	2,954	6,314	
Solar Thermal	35%	6,405	15,824	
Wind	39%	7,091	20,741	
33% RES Energy Req'd	100%	*18,493*	*58,118*	

2020 LOW Net Short				Load Adjustments:
Type	**%**	**MW**	**GWh**	Energy Efficiency: 24,200 GWh CHP: 30,222 GWh Solar DG: 2,030 GWh *T&D Losses (8.5%)* *Scoping Plan Measures* Total Load 250,000 GWh 20% RPS Energy Req'd 19,000 GWh
Small Hydro	0.2%	40	177	
Biogas	0.2%	30	223	
Biomass	2.0%	328	2,297	
Geothermal	7.8%	1,299	9,963	
Solar PV	17%	2,867	6,127	
Solar Thermal	30%	4,907	11,984	
Wind	43%	7,091	20,741	
33% RES Energy Req'd	100%	*16,561*	*51,511*	